

# PATENT SPECIFICATION (11)

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## (54) "IMPROVEMENTS IN AND RELATING TO CHEESE"

(71) We, FUJI OIL CO., LTD., a Japanese Body Corporate, of 12, 2-Chome, Azuchimachi Higashiku, Osaka, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to processed cheese and, more particularly to methods of making firm, cuttable, processed cheese-like, products from soy cheese as a part or the major ingredient thereof.

In a hitherto proposed process for making processed dairy cheese, one or more lots of natural dairy cheese are ground, melted and blended with various seasoning materials. The melted or liquefied product is then extruded or otherwise introduced into form of desired shape, cooled, and packaged for direct sale to the consumer. Several different kinds of natural cheeses can be mixed together and used as the raw material. Also, natural dairy cheeses of different ripeness and even cheeses with inferior texture and flavour can be used as the raw material. It is known that so-called melting salts, such as sodium phosphates, sodium citrate and sodium tartrate, can be added to the cheese to enhance melting.

In addition to being able to use otherwise unacceptable cheeses, processed dairy cheese has many other advantages, such as long shelf life because of the pasteurization during processing, a mild taste which is preferred for many uses, the flavour and texture can be adjusted as desired by changing the type and proportions of dairy cheeses used, and a highly uniform quality.

Although many methods have been proposed for producing so-called soy cheese from soy protein, soy cheese has not become widely used. One of the primary draw backs to a more widespread use lies in the fact that natural soy cheeses are not readily adaptable as a raw material in conventional processes

for making processed cheese. Therefore, the advantages associated with processed dairy cheeses have not heretofore been available to soy cheeses.

When heated to melting temperatures, natural soy cheeses tend to coagulate into a rubbery mass and, in some cases, the fats tend to separate therefrom. The melting salts used for natural dairy cheeses are not effective for eliminating these problems. When the melting salts are added to natural soy cheeses in amounts ordinarily used for making processed dairy cheeses, there is very little softening. Larger amounts of the melting salts only soften the natural soy cheeses to a consistency resembling cheese spread. Upon being packaged, such a softened product has a fragile texture and lacks good cohesiveness.

According to the present invention there is provided a method of making a firm, cuttable, processed cheese-like product from natural soy cheese, the method comprising mixing the cheese under high shear with a casein-containing substance derived from animal milk and a melting salt, the casein-containing substance and the melting salt each being present in the resulting mixture in an amount such that the mixture melts on heating; heating the mixture to a temperature of not more than 85°C to effect melting thereof; and cooling the heated mixture to form a processed cheese-like product.

The invention further provides a method of making a firm, cuttable, processed cheese-like, product from one or more natural soy cheeses, the method comprising the steps of:—

mixing a casein-containing substance derived from animal milk and a cheese-emulsifying melting salt under high shear with the natural soy cheese, the amount of casein-containing substance being at least 1 part by weight, calculated as casein, per 100 parts by weight of the natural soy cheese, the melting salt being present in an amount such

that in combination with the casein-containing substance, the natural cheese is melted to a liquefied state upon heating;

- 5 melting the mixture by heating to a temperature of not more than 85°C;

introducing the melted mixture into a container; and

cooling the melted mixture to form a processed cheese-like product.

- 10 The invention still further provides a method of making a firm, cuttable, processed cheese-like, product from one or more natural soy cheeses, the method including the step of mixing a casein-containing substance selected from sodium caseinate, dairy cheese, whole milk solids, skimmed milk solids, and mixtures of two or more thereof, and a cheese-emulsifying melting salt selected from sodium polyphosphates, sodium metaphosphates, sodium tartrate, and mixtures of two or more thereof, with the natural soy cheese under high shear, the amount of casein-containing substance in the resulting mixture being at least 1 part by weight, calculated as casein, per 100 parts by weight of the natural soy cheese, and the amount of melting salt in the resulting mixture being from 1 to 5 weight % based on the total weight of natural soy cheese and casein-containing compound calculated as casein, heating the mixture to a temperature of not more than 85°C to effect melting thereof, and cooling the heated mixture to form a processed cheese-like product.

- 35 The natural soy cheese can be any conventional soy cheese which has a protein content substantially made up of soy protein and is fermented by a lactic acid cheese starter culture. The natural soy cheeses can be coagulated by conventional soy cheese coagulating agents including alkaline earth metal salts, such as calcium sulphate, magnesium sulphate, magnesium chloride, calcium chloride, a sugar acid lactone, such as gluconic-delta lactone and uronic acid lactones, and organic acids, such as acetic acid, lactic acid and citric acid. Representative examples of suitable natural soy cheeses are described in FOOD TECHNOLOGY, Volume 1, pp. 95-6 (July, 1967).

- 50 As in processes for preparing processed dairy cheeses, natural soy cheeses from two or more different lots can be mixed together to provide a more mellowed flavor. When such mixing is used, a natural soy cheese which is slightly over ripened, i.e., has a Nitrogen Soluble Index (NSI) greater than 30 and a natural soy cheese which is slightly under ripened, i.e., has a NSI less than 30, can be mixed together, preferably in proper proportions to provide a mixture of natural soy cheeses having an overall NSI of about 30. (The NSI is a measure of the degree of ripeness of a cheese measured for example as described in "Cereal Laboratory Method",

7th Edition, 1972, American Association of Cereal Chemists, Inc, New York). Upon being heating to melting, a mixture of natural soy cheeses having NSI of about 30 has a suitable ripeness both in flavour and in texture.

When a processed product having a very bland flavour is desired, the overall NSI thereof can be lower than 30. In this case, very young natural soy cheese and even "green" natural soy cheese, i.e., uncured soy cheese, can be used if the grinding and/or mixing is performed with a high shearing device, such as a high speed rotary cutter, colloid mill or calendar, which imparts a high shearing force to the young curd and work it into a flowable form. Although "green" soy cheese typically has a NSI of about 4, a well textured processed product can be made therefrom by the invention when grinding and/or mixing is performed with such a device.

The casein-containing substance used in this invention contains casein derived from animal milk and is suitable for human consumption. The preferred casein-containing substances are sodium caseinate, dairy cheese, whole milk solids, skim milk solids, and mixtures thereof, with sodium caseinate being the most preferred. As used herein, the term dairy cheese denotes cheeses produced from natural milk fractions.

The amount of casein-containing substance added to the natural soy cheese varies depending upon the particular casein-containing substance as casein per 100 parts by weight of natural soy cheese is added. When a casein-containing substance other than dairy cheese is used, the amount added is preferably within the range of 1 to 10 parts by weight as casein per 100 parts by weight of natural soy cheese. Amounts of these casein-containing substances less than 1 part generally are not effective in producing a satisfactory melting of natural soy cheeses, while amounts in excess of 10 parts tend to cause fat separation, produce an unsmooth, gummy curd during melting and impart an undesirable flavor to the resultant product. Since dairy cheeses already are in curd form and can be processed without coagulating into a rubbery mass, larger amounts of same can be used even though it is used as the sole casein-containing substance.

The melting salts used in this invention can be any of the so-called cheese emulsifying agents used in preparing processed dairy cheese. The preferred melting salts are selected from the group consisting of sodium phosphates, such as disodium phosphate and trisodium phosphate, sodium pyrophosphates, such as sodium acid pyrophosphate, tetrasodium pyrophosphate, sodium polyphosphates, sodium metaphosphates, such as sodium hexametaphosphate, sodium citrate, sodium tartrate,

dipotassium phosphate, potassium citrate, calcium citrate, sodium potassium tartrate and mixtures thereof, with sodium polyphosphates, sodium metaphosphates, sodium citrate and mixtures thereof being the most preferred. The amount of melting salts used depends primarily on the ripeness and quality of the natural soy cheese and the quantity of casein-containing substance used, with larger amounts being used when cheese is young. Generally, the amount of melting salt used is from 1 to 5 weight %, preferably from 1 to 3 weight %, based on the total weight of the natural soy cheese and the casein-containing substance as casein. When the natural soy cheese is ground and/or mixed with a high speed shearing device, such as a Stephan Silent Cutter, marketed by A. Stephan and Sohne, Hameln, Western Germany or T. K. Microider Chopper Colloid Mill, marketed by Tokushu Kika Industries, Osaka, Japan, smaller amounts of the melting salts can be used.

As mentioned above, the use of a melting salt alone will not provide satisfactory melting of natural soy cheeses. Increasing the amount of the melting salt used to levels substantially above that normally used in processing natural dairy cheese e.g., 2 to 3 weight %, provides some softening. However, rather than melting into a softened state upon heating, i.e., flowable consistency suitable for making an acceptable processed product, this softened soy cheese has a consistency resembling cheese spread. With such a consistency the resultant processed product has a fragile texture and lacks a suitable cohesiveness. On the other hand, the addition of a casein-containing substance alone has little or no effect on the ability of natural soy cheese to melt satisfactorily. To obtain satisfactory melting of cheese for the producing of an acceptable processed product, both additives must be used. As used herein, processed soy cheese, denotes a processed cheese-like product including processed soy cheese, processed soy cheese food, and processed soy cheese spread, containing soy cheese as a part or the major ingredient.

Other than adding both a casein-containing substance and a melting salt to the natural soy cheese before melting, the remaining steps for making a processed cheese-like product in accordance with the invention can be carried out substantially in the same manner as that used for making processed dairy cheeses. The natural soy cheese, and the dairy cheese if used as the casein-containing substance, are preferably first ground up in a suitable manner. The particle size of the ground cheese is not particularly critical so long as the particles are small enough to facilitate homogeneous dispersion of the additives (and the different cheeses when more than one lot or types of

cheeses are used) and to facilitate melting within a reasonably short time period.

The ground cheese, the casein-containing substance and the melting salt are thoroughly mixed in a suitable manner and for sufficient time to obtain a substantially homogeneous mixture thereof. For example, the mixing can be carried out in a conventional type homogenizer operating at about 600 R.P.M. with a mixing time of 10 to 40 minutes. As in processes for preparing processed dairy cheeses suitable amounts of water, neutralizing agents, such as sodium carbonate, coloring matter, and/or preservatives can be added to the cheese during the mixing step, if desired.

The resultant mixture is then heated in a suitable heating vessel, such as a conventional steam injected pasteurizing kettle including agitation means for stirring, to melt the natural soy cheese, and the dairy cheese if used. Although the heating conditions are not particularly critical, so long as the cheeses is of a softened, flowable consistency, the mixture is preferably heated at a temperature of 80 to 85°C for 10 to 15 minutes. Temperatures much above 85°C should be avoided in order to prevent separation and/or decomposition of the fat in the soy cheese and to prevent denaturation of protein.

The softened mixture is then introduced into forms or packages in the usual manner and cooled to 5-10°C to obtain a processed cheese-like product. If desired, the softened mixture containing soy cheese can be blended with a melted dairy cheese before packaging and cooling.

The following Examples are given by way of illustration only.

#### EXAMPLE 1

A quantity of soy cheese was prepared by adding 3% of a partially hydrogenated palm oil, 2% of lactose, and a cheese flavoring to a soy milk extracted from defatted soy bean protein, fermenting this mixture with a lactic acid cheese starter culture, and coagulating the fermented broth with about 0.3% calcium sulfate to form a curd. One sample (A) of the soy cheese curd was aged for about 12 weeks (NSI = 39, pH = 5.6 and moisture content = 59%) and another sample (B) of the soy cheese curd was aged for 6 weeks (NSI = 17.5, pH = 5.25 and moisture content = 60%). After 100 parts of sample A and 50 parts of sample B were ground and mixed together, 5 parts of sodium caseinate and 5 parts of sodium tripolyphosphate were added thereto and the mixture thereafter homogenized for 30 minutes in a Universal homogenizer (marketed by Nippon Seiki Seisakusho, Tokyo, Japan) set at 6000 R.P.M. The resultant mixture was melted by heating and stirring at a temperature of 80-85°C for 15 minutes. The melted mixture was then packaged and cooled to about 5°C. The thus-

produced processed cheese-like product had the following analysis:

NSI = 30.9, pH = 6.0 and moisture content = 58%, and had a mild flavor and a superior keeping quality.

As a control, a mixture of the ground soy cheese samples was processed in the same manner except the sodium casein was not added to the mixture before melting. During the heating step, the soy cheeses were only slightly softened instead of melting. The softened mixture was forced into a package and cooled. The resultant product has a pH of 6.05 and a very coarse, nonuniform texture.

In another control, a mixture of the ground soy cheese samples was processed in the same manner except neither the sodium caseinate nor the tripolyphosphate melting salt was added to the mixture before heating. During the heating step, the mixture coagulated into a rubbery mass and could not be further processed.

#### EXAMPLE 2

100 parts of a soy cheese sample A prepared in Example 1 and 25 parts of Edam cheese were ground individually and mixed together. 3.7 parts of sodium caseinate and 4 parts of a polyphosphoric acid melting salt (Takeda 4A, marketed by Takeda Chemical Industries Ltd., Osaka, Japan and consisting of about 35 wt% sodium polyphosphate, about 15 wt% sodium metaphosphate, about 45 wt% sodium pyrophosphate, and about 5 wt% dibasic sodium phosphate) were added to the mixture. The resultant mixture was thereafter melted and processed in the same manner as described in Example 1.

The resultant cheese-like product had a pH of 6.25, a moisture content of 54.4% and a suitable texture.

#### EXAMPLE 3

Soy cheese was prepared by adding 3% of a synthetic fat composition having properties resembling milk fat and 2% of glucose to a soy milk prepared from defatted soy bean protein, fermenting the mixture with a lactic acid cheese starter culture, coagulating the fermented broth with 0.2% of glucono-delta-lactone to form a curd, and aging the curd for 10 weeks. 100 parts of the thus-produced soy cheese (NSI = 28.4, pH = 5.3 and moisture content = 57.2%) and 100 parts Gouda cheese were ground and mixed together, and 6 parts of a sodium tripolyphosphate melting salt and 2 parts of a neutralizing agent, were added to the cheese mixture. The resultant mixture was thoroughly mixed and thereafter heated to melting in a pasteurizing kettle. The liquefied mixture was then packaged and cooled to obtain a highly satisfactory processed cheese-like product.

#### EXAMPLE 4

100 parts of soy cheese sample A prepared in Example 1 and aged for 7 months was

ground and 7 parts of sodium caseinate, 0.5 parts of a neutralizing agent, 1 part of sodium citrate and 15 parts of water were mixed therewith in a high speed shearing device (Stephan) for about 80 minutes. This mixture was then heated in a pasteurizing kettle at a temperature of about 80°C and a pressure of about 25mm Hg for 20 minutes to melt. The melted mixture was packaged and cooled in the same manner as in Example 1 and a satisfactory processed cheese-like product was obtained. Thus, it can be seen that a casein containing substance and smaller amount of the melting salt can provide satisfactory melting of soy cheese when a high speed shearing device is used.

#### EXAMPLE 5

100 parts of the green soy cheese curd prepared in Example 1, which was not aged and had a NSI of 4, were cut into small cubes and mixed with 4 parts of sodium caseinate, 10 parts of sodium hexametaphosphate, and 0.4 part of sodium carbonate in a high speed shearing device (T. K. Microider). The mixture was thereafter heated at a temperature of 85°C to melt. At the end of the heating a small amount of coloring material and flavoring material were added into the melted mixture. The mixture was then packaged and cooled to 5°C to obtain a processed soy cheese product having bland flavor free from unfavorable beany odor and very good texture.

The results from the above examples show that natural soy cheeses cannot be made into a satisfactory processed cheese-like product unless both a casein-containing substance, such as sodium caseinate or a dairy cheese, and a melting salt, such as sodium tripolyphosphate, polyphosphoric acid, sodium citrate, and sodium hexametaphosphate, are added to the soy cheese prior to melting.

#### WHAT WE CLAIM IS:—

1. A method of making a firm, cuttable, processed cheese-like, product from natural soy cheese, the method comprising mixing the cheese under high shear with a casein-containing substance derived from animal milk and a melting salt, the casein-containing substance and the melting salt each being present in the resulting mixture in an amount such that the mixture melts on heating; heating the mixture to a temperature of not more than 85°C to effect melting thereof; and cooling the heated mixture to form a processed cheese-like product.

2. A method of making a firm, cuttable, processed cheese-like, product from one or more natural soy cheeses, the method comprising the steps of:—

mixing a casein-containing substance derived from animal milk and a cheese-emulsifying melting salt under high shear with the natural soy cheese, the amount of casein-containing substance being at least 1

- part by weight, calculated as casein, per 100 part by weight, calculated as casein, per 100 parts by weight of the natural soy cheese, the melting salt being present in an amount such that in combination with the casein-containing substance, the natural cheese is melted to a liquefied state upon heating;
- 5 melting the mixture by heating to a temperature of not more than 85°C;
- 10 introducing the melted mixture into a container; and
- cooling the melted mixture to form a processed cheese-like product.
3. A method according to claim 1 or 15 claim 2, wherein the casein-containing substance comprises sodium caseinate, dairy cheese, whole milk solids, skimmed milk solids, or a mixture of two or more thereof.
4. A method according to any of the 20 preceding claims, wherein the amount of casein-containing substance used is from 1 to 10 parts by weight, calculated as casein, per 100 parts by weight of the cheese.
5. A method according to claim 1, 25 wherein the casein-containing material is sodium caseinate.
6. A method according to any of the preceding claims, wherein the melting salt comprises a sodium phosphate, a sodium 30 pyrophosphate, a sodium polyphosphate, a sodium metaphosphate, sodium citrate, sodium tartrate, dipotassium phosphate, potassium citrate, calcium citrate, sodium potassium tartrate, or a mixture of two or more thereof.
7. A method according to claim 6, 35 wherein the melting salt is used in an amount of from 1 to 5 weight %, based on the total weight of natural soy cheese and casein-containing substance calculated as casein.
8. A method according to claim 1, 40 wherein the melting salt comprises a sodium polyphosphate, a sodium metaphosphate, sodium citrate, or a mixture of two or more thereof.
9. A method according to any of the preceding claims, wherein the overall 45 Nitrogen Soluble Index of the natural cheese is about 30.
10. A method according to any of the 50 preceding claims, wherein the heating is effected at a temperature of from 80 to 85°C for 10 to 15 minutes.
11. A method according to any of the preceding claims, wherein the melted mixture 55 is blended with a melted dairy cheese before cooling.
12. A method of making a firm, cuttable, processed cheese-like, product from one or more natural soy cheeses, the method 60 including the step of mixing a casein-containing substance selected from sodium caseinate, dairy cheese, whole milk solids, skimmed milk solids, and mixtures of two or more thereof, and a cheese-emulsifying 65 melting salt selected from sodium polyphosphates, sodium metaphosphates, sodium tartrate, and mixtures of two or more thereof, with the natural soy cheese under high shear, the amount of casein-containing substance in the resulting mixture being at least 1 part by weight, calculated as casein, per 100 parts by weight of the natural soy cheese, and the amount of melting salt in the resulting mixture being from 1 to 5 weight % based on 75 the total weight of natural soy cheese and casein-containing compound calculated as casein, heating the mixture to a temperature of not more than 85°C to effect melting thereof, and cooling the heated mixture to form a processed cheese-like product.
13. A method according to claim 12, 80 wherein the resulting mixture is heated at a temperature of 80 to 85°C for 10 to 15 minutes.
14. A method according to claim 13, 85 wherein the amount of casein-containing material used is from 1 to 10 parts by weight, calculated as casein, per 100 parts by weight of soy cheese.
15. A method according to claim 1, claim 2 or claim 12, substantially as herein described.
16. A method according to claim 1, 95 substantially as herein described with reference to any of the Examples.
17. A firm, cuttable, processed cheese-like, product when made by a method according to any of the preceding claims. 100

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